U.S. Department of Energy
Energy Efficiency and Renewable Energy

Utah Energy Forum

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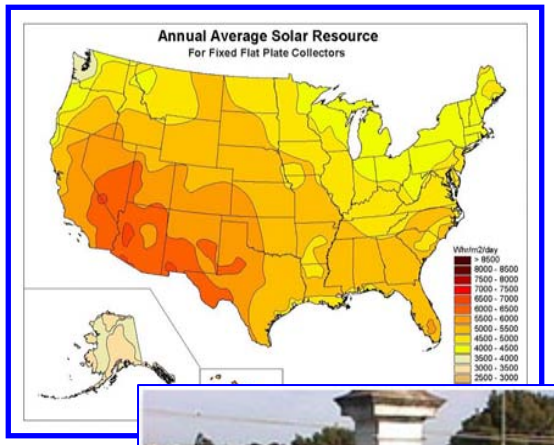
Solar Energy Applications

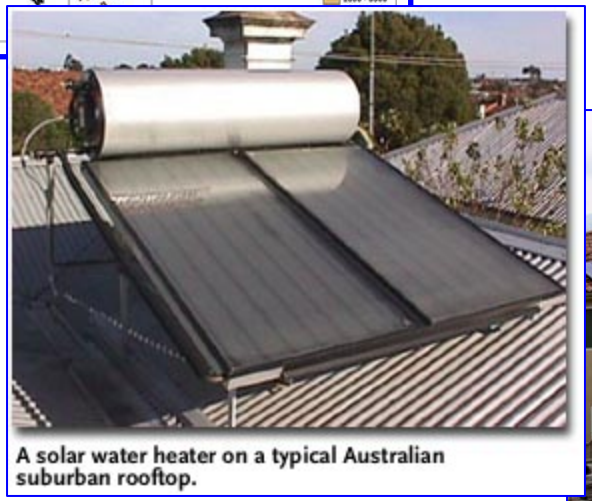


Distributed uses

- Heating and cooling
- Domestic hot water
- Roof-top PV electricity

Larger-Scale uses

- *Utility Scale Power*



A solar water heater on a typical Australian suburban rooftop.

What is CSP?

Solar concentration allows tailored design approaches for central and distributed power generation.

*Also known as Solar Thermal Electric Power

What can CSP do?

Concentrating Solar Power has demonstrated:

- Utility-Scale Solar Power
- Thermal energy is collected and used to "drive" an engine/generator
- High capacity factor dispatchable power with thermal storage or hybridization
- 130 plant-years of commercial operation demonstrated (9 plants, 354 MW)
- 80 MW/year production/installation capacity
- Trough are most mature technology
- Current bid costs are in the range of 12 – 16 ¢/kWhr

SEGS Plants

- Solar Electric Generating Stations (SEGS): 354 MW
- Operating since 1985 producing more than 650 GWhrs/yr
- Total annual average solar-to-electric efficiency at 12%.
- Plants are "hybridized" for dispatchability (25%)

Total reflective area > 2.3 Mill. m^2

More than 117,000 HCEs

30 MW increment based on regulated power block size

1-MW Organic Rankine Cycle Plant at APS

APS Saguaro Solar Plant

Commissioned November 2006

Nevada Solar One

- 64 MW Capacity
- 357,200m² Solar Field
- 30 Minutes Thermal Storage
- Minimal Fossil fuel
- Long term PPA signed with Nevada Power
- EPC Notice to Proceed – January 2006
- Commissioned June 2007

SOLARGENIX ENERGY
THE NATURAL POWER FOR GOOD
an acciona company

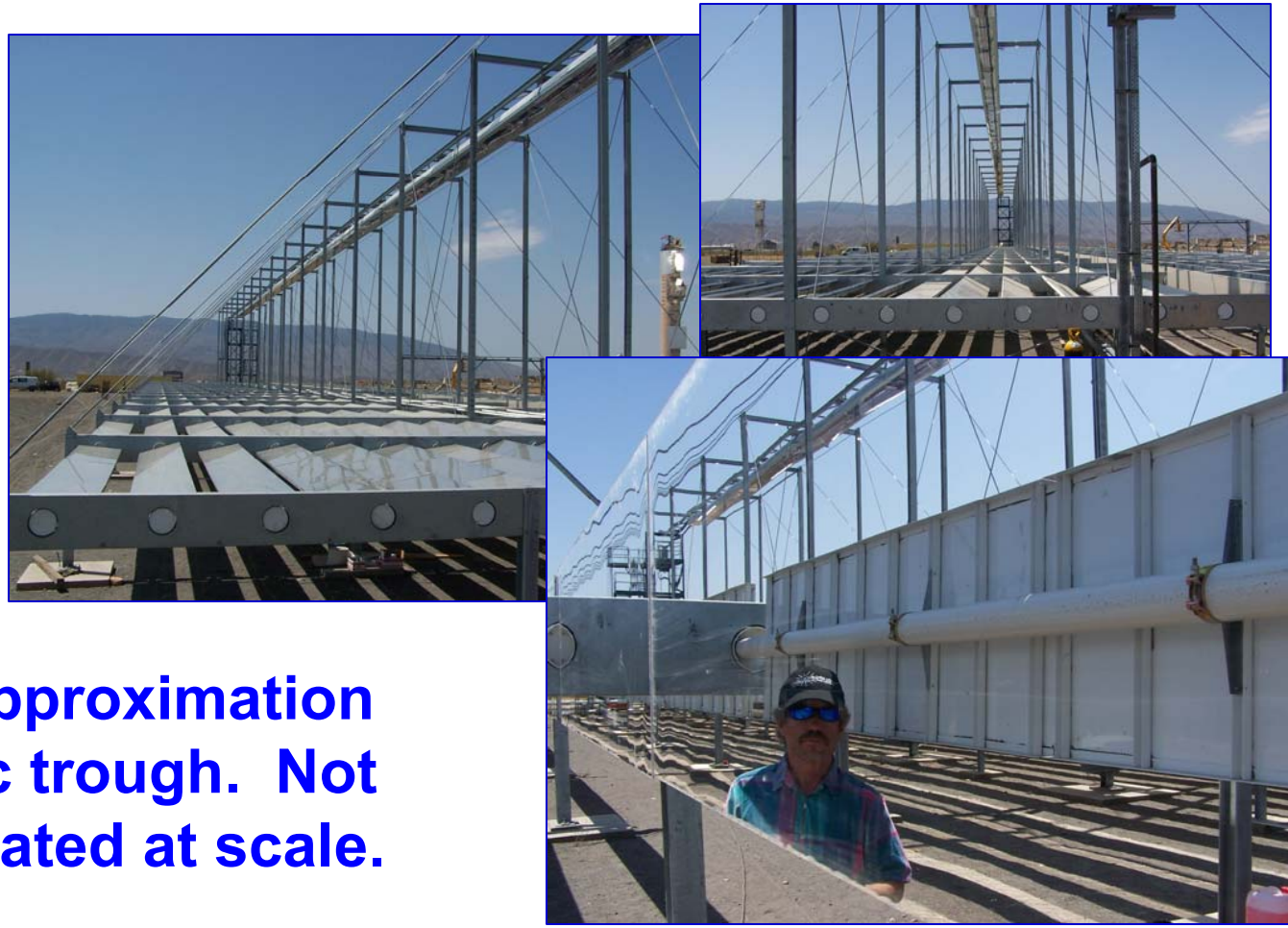
CLFR

Continuous Linear Fresnel Reflector

AUSRA

SPG

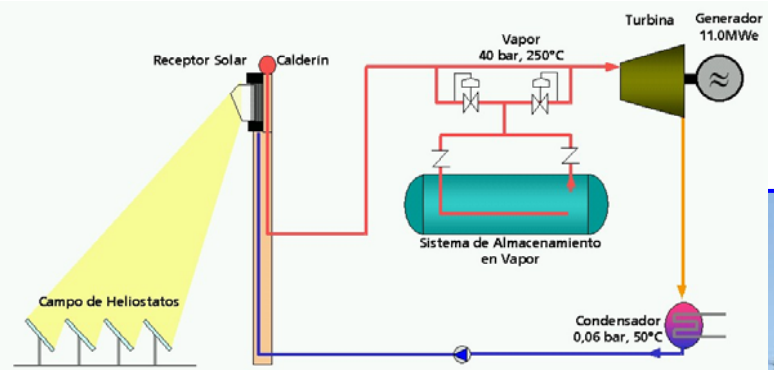
SKYFUEL



CLFR is an approximation of a parabolic trough. Not yet demonstrated at scale.

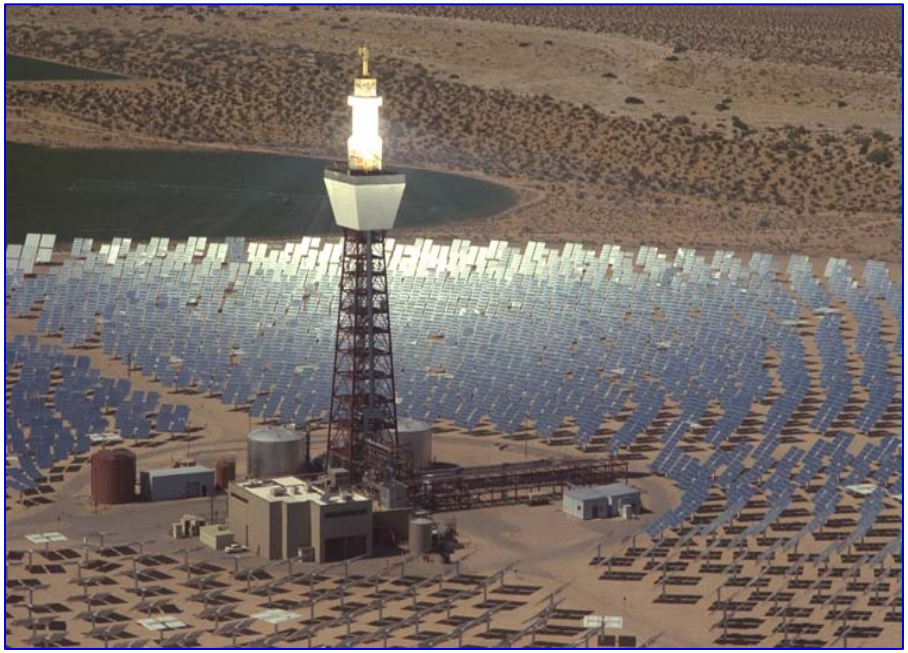
PS 10 Power Tower

PS 10 Plant Operational in Spain in the Fall 2006. Construction started on PS 20 Plant.



Solar Two Results

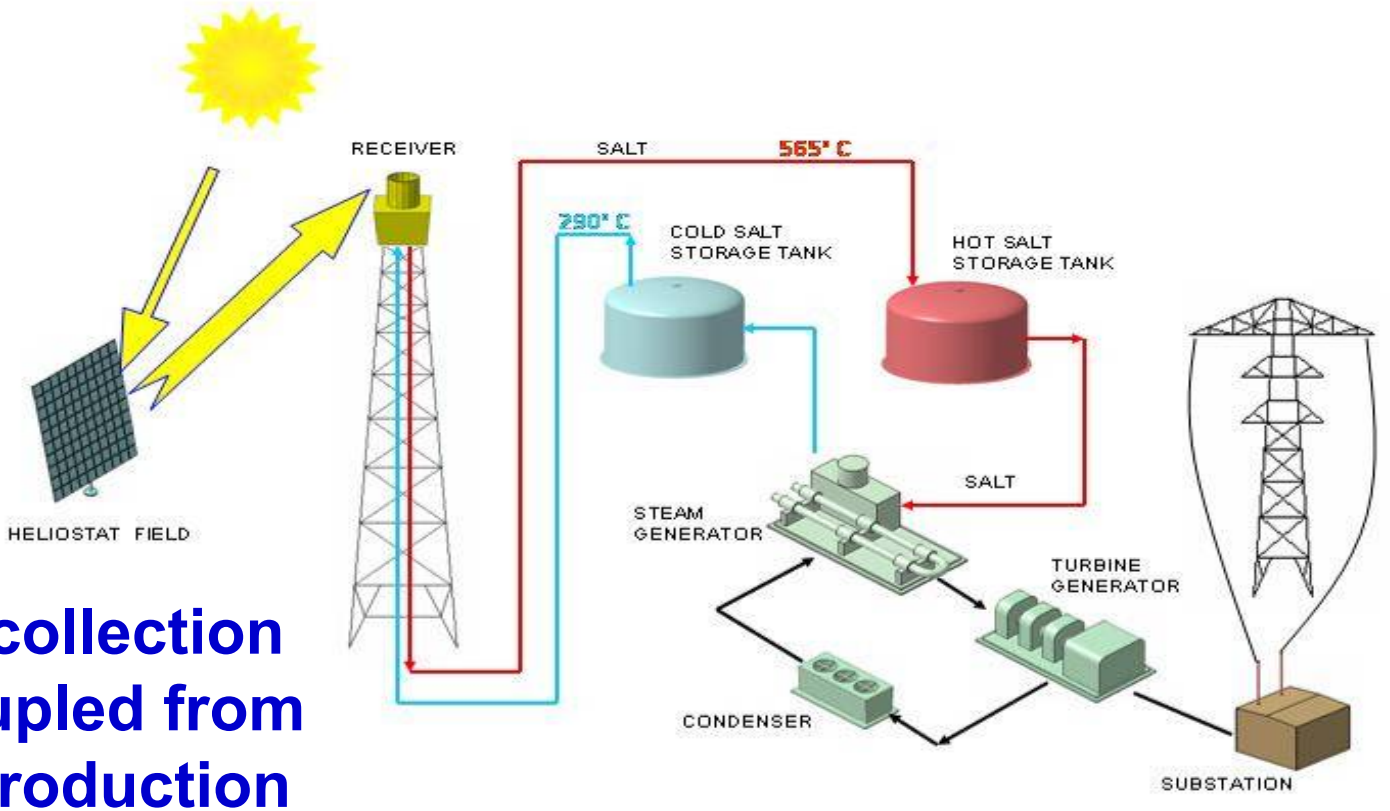
10 MW Molten-Salt Power tower technology was success- fully demonstrated at Solar Two and all of the test objectives were met.



- Receiver design validated
- Receiver η = 88%
- η of Storage > 98%
- Dispatchability demonstrated for > 6 days
- 40MW (equivalent) Solar Tres plant prop. in Spain

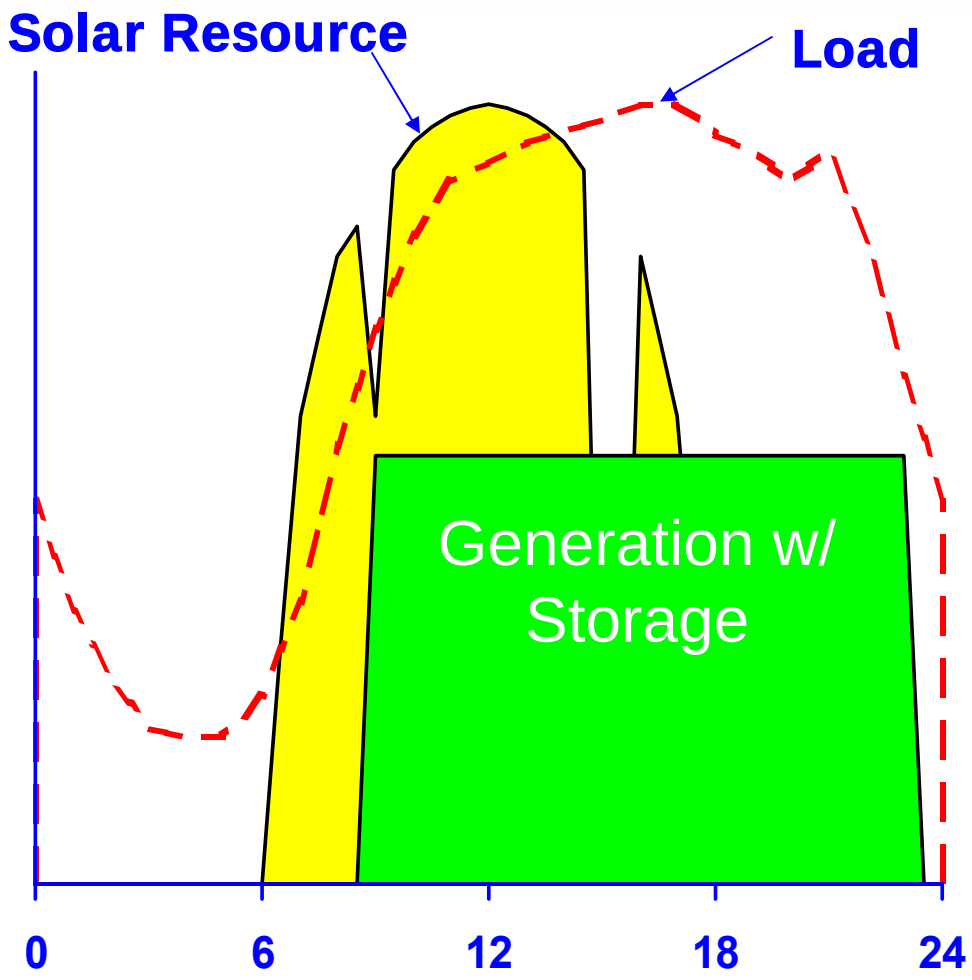
Molten-Salt Power Tower

Power Tower or "Central Receiver"



Energy collection is uncoupled from power production

The Value of Storage Dispatchable Power



Storage/hybridization provide

- **decoupling** of energy collection and generation
- **lower costs** because storage is cheaper than incremental turbine costs
- **higher value** because power production can match utility needs

CSP Dish Stirling Systems

SES Technology Features:

- High efficiency (Peak > 30% net solar-to-electric)
- Annual Efficiency ~ 22 – 25 %
- Modularity (10, 25kW)
- Autonomous operation
- High-Efficiency Stirling Engine

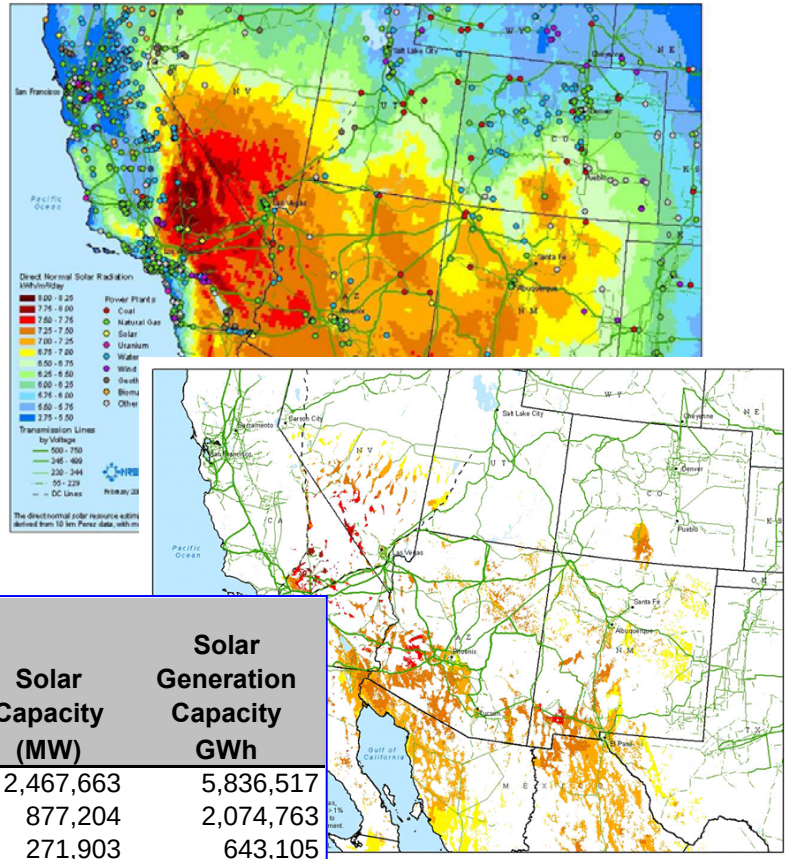
R&D focus is on Reliability improvement, engineering for mass production and cost reduction.

DNI Solar Resource in the Southwest

Screening Approach

Filters applied:

- Direct-normal solar resource.
- Sites > 6.75 kwh/m^2/day.
- Exclude environmentally sensitive lands, major urban areas, etc.
- Remove land with slope > 1%.
- Only contiguous areas > 10 km^2



Bottom Line:
Almost 7,000 GW available Resource (Total U. S. Capacity is 950 GW)

State	Land Area (mi^2)	Solar Capacity (MW)	Solar Generation Capacity GWh
AZ	19,279	2,467,663	5,836,517
CA	6,853	877,204	2,074,763
CO	2,124	271,903	643,105
NV	5,589	715,438	1,692,154
NM	15,156	1,939,970	4,588,417
TX	1,162	148,729	351,774
UT	3,564	456,147	1,078,879
Total	53,727	6,877,055	16,265,611

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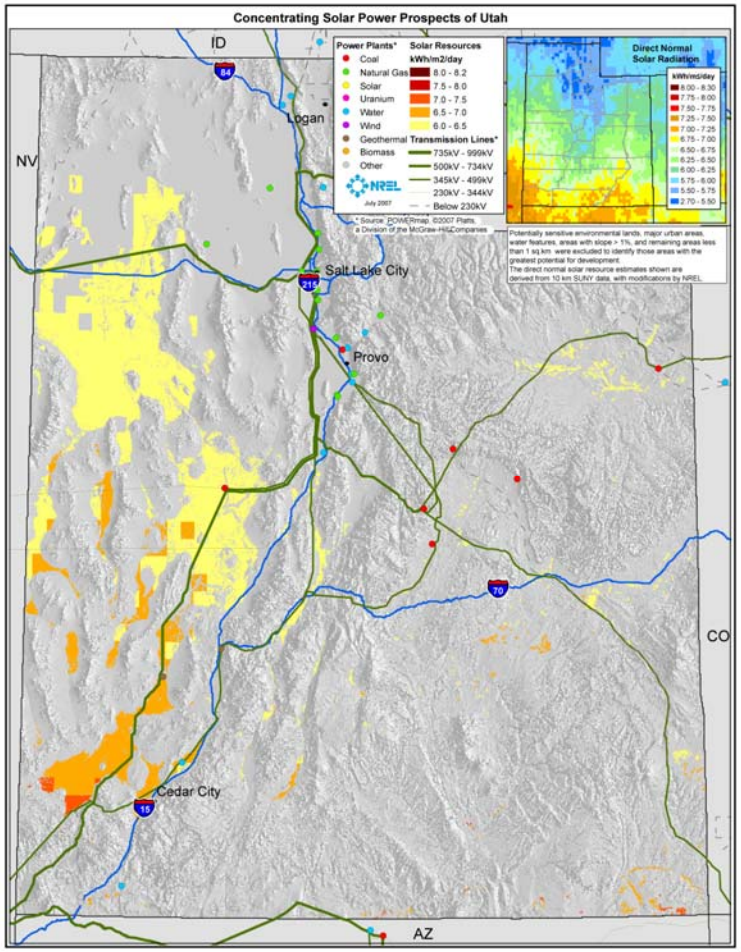
Utah's Potential

Utah has the potential for more than 450,000 MW of CSP capacity

With new transmission, Utah could export large amounts of clean energy



Benefits to Utah

Based on deploying a 100 MW CSP plant, Utah would realize the following economic benefits*

Construction	1016 jobs
Operation	38 jobs
Average Wage*	$45,800
Private Investment	$370 million
30-Year Tax Gain	$200+ million

* Based on studies for CA, NV, and NM.

Benefits to Utah

*If Utah were to build 1000 MW**

$2 - 4 billion private investment in State

3,000 to 4,000 construction jobs

250 permanent solar plant jobs, many in rural areas

$1.0 billion increase in state tax revenues

<u>Potential for In-state manufacturing</u>: For each 1000MW built outside of the state, Utah would realize approximately $447M income and 14,000 jobs

*** Scaling the results to New Mexico of a study done for California.**

Projects in SW U. S.

- 1 MW trough/ORC in Arizona (APS, Solargenix) commissioned Nov 2006.
- 64 MW trough electric project in Nevada (Nevada Power, Solargenix) commissioned in June 2007.
- 500 (option to 850 MW) Dish Stirling plant in Southern California (SCE, SES). Agreement signed Aug 2005.
- 300 (option to 900 MW) of Dish Stirling plants in Southern CA (SDG&E, SES). Agreement signed in Sep 2005.
- 553 MW PPA announced July 25, 2007 with Solel for parabolic trough power plant
- 400 MW distributed power tower Brightsource Energy announces in California, Sept. 6, 2007
- 300 MW FPL announces working with AUSRA and possible in Florida
- 177 MW AUSRA PPA with PG&E Nov. 5, 2007
- ~ 450 MW Two SW Consortia in the planning stages totaling
- Other RFQs for PPAs pending (LADWP, APS, SCE, PG&E, SDG&E,)